Environmental Resources Management

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2 December 2005

Mr. Todd Slater
Manager, Environmental Technologies and Remedial Procurement
Health, Environment and Safety
Arkema Inc.
900 First Avenue
King of Prussia, Pennsylvania 19406-0936

Subject: Work Plan for Performance Evaluation the AS/SVE IRM
Arkema Inc. Portland Facility

Dear Todd:

ERM-West, Inc. (ERM) has prepared this Work Plan to detail the scope of a focused evaluation of the performance of the air sparging/soil vapor extraction (AS/SVE) interim remedial measure (IRM) currently operating to treat highly-concentrated dissolved monochlorobenzene (MCB) and MCB dense non-aqueous phase liquid (DNAPL) in groundwater at the Arkema Inc. (Arkema) facility in Portland, Oregon (the "site"). The purpose of this evaluation is to determine the effectiveness of the current AS/SVE system and to develop recommendations, if necessary, to enhance the performance of the AS/SVE IRM such that the cleanup can be completed on schedule. The layout of the AS/SVE system and the approximate extent of the residual DNAPL is shown on Figure 1.

PROJECT BACKGROUND

The Arkema Inc. (Arkema), formerly ATOFINA Chemicals, Inc. (ATOFINA), property is a former chemical manufacturing facility located adjacent to the Willamette River in the northwest industrial area of Portland, Oregon. MCB was used at the site as a raw material in the DDT manufacturing process. MCB and DDT have impacted ground water and soil within the former DDT manufacturing area. An AS/SVE system was installed in the shallow zone aquifer in December 2004 to treat the MCB DNAPL. Groundwater sampling during the first 10 months of operation have indicated that dissolved concentrations of MCB have reduced significantly, but fluctuate greatly and preclude any

definite conclusion regarding the success of the AS/SVE system at reducing the mass of DNAPL in all of the treatment area.

TECHNICAL APPROACH

This evaluation includes assessing DNAPL thickness at points midway between most AS wells in the DNAPL area and at points close to one of the AS wells. The results will be compared to the DNAPL conditions observed during installation of the respective AS wells. This technical approach is designed to provide the data needed to assess the continued operation of the AS/SVE system, the need to increase the density of the AS well network, and determine the mass of oxidant required to treat residual DNAPL.

SCOPE OF WORK

The scope of this work will include the collection of soil samples from 15 boring locations using a direct push drilling rig. A four-foot soil core will be collected from the bottom of the shallow zone in each boring. Each sample will be visually inspected for DNAPL (use dye as appropriate), vapor concentrations will be measured from various locations in each sample core using a photo-ionization detector (PID), and an estimate of the thickness and percent pore space of the DNAPL will be made for each soil core. Select samples will be collected for laboratory analyses of volatile organic compounds (VOCs). As shown on Figure 2, the borings will be advanced at the following locations:

- GP-7, to assess the amount of DNAPL present at the mid-point between AS-1, AS-6 and AS-7, where the AS system likely has the least impact on DNAPL removal.

- GP-8, to assess the amount of DNAPL midway between AS-6 and GP-7 so that the effective radius of influence of AS-6 can be determined.

- GP-9 and GP-10, to assess the amount of DNAPL present at distances of 8 and 16 feet from AS-1 so the effective radius of influence of AS-1 can be determined.

- GP-11 through GP-19, to assess the amount of DNAPL present at the mid-point between the three closest AS wells.

- GP-20 and GP-21, to assess the amount of DNAPL reduction that has occurred in the vicinity of AS-6.

Soil Boring Procedures

The soil boring at each of the 15 boring locations will be advanced using a direct push drilling rig and dual-tube sampling equipment having the ability to performed discreet depth sampling. The dual tube tooling is being used because: (1) it allows each boring to be continuously cased to prevent potential cross contamination between water bearing zones, and to assure the hole is fully grouted from the bottom up, and (2) it allows a solid tip to be advanced to the target depth to minimize the amount of investigation derived waste generated. The soil boring will be advanced as follows:

- The outer tube of the direct push sampler with a solid point installed in the bottom will be advanced to the target of approximately 30 feet below ground surface (ft-bgs). The actual target depth for each boring based on the depth at which the silt was encountered at previous nearby borings is indicated in Table 1.

- The outer rods will be filled with potable water to prevent sand heave, the solid tip at bottom of the outer casing will be removed and the soil sampler will be advanced down the inside of the tooling to the depth of the outer casing.

- The soil sampler and outer casing will be advanced together for four feet to collect the soil core.

- The soil sampler will be removed leaving the outer casing in place to keep the hole open. Additional water may be needed to prevent the soil sampler from becoming locked inside of the outer casing due to sand heave.

- The soil sample will then be opened and examined. If the soil sample indicates that the shallow zone boundary silt has been reached, then the boring can be abandoned. If the sample does not include the boundary silt or DNAPL conditions indicative of the

shallow zone boundary silt, the soil sampler will be advanced by another 6 inches and the additional sample will be evaluated. If the silt is not observed in the second sample, the project manager will be contacted and the next step will be determined based on an evaluation of the boring logs for the nearest borings as well as the new boring.

All soil cores will be logged for soil lithology using USCS soil designations and will be screened at least every six inches using a PID by placing a small aliquot of soil in a clean polyethylene bag, breaking the sample up to promote volatilization, and then monitoring the headspace in the bag. Any visual evidence of sheen or DNAPL will be noted and any sample without conclusive visual DNAPL will be screened with an oil miscible organic dye such as Sudan IV or Oil Red O. The approximate thickness of any DNAPL deposit will be measured, and an estimate will be made of the volume of pore space occupied by the DNAPL.

All borings will be abandoned with bentonite grout mixed to appropriate weight injected through the outer probe casing from the bottom of the hole to at least the top of the water table. The boring may then be backfilled with bentonite chips to 1 foot below ground surface. All chips must be hydrated for at least 1-hour prior to repair of the surface with asphalt or concrete as appropriate.

Sample Collection Procedures

The mass of MCB in the soil is a key factor in determining the mass of persulfate needed to treat the MCB, and thus the cost of the remediation. To calibrate our DNAPL field observations and to determine the mass of MCB sorbed to the soil, four soil samples (two containing visible DNAPL and two without visible DNAPL) will be collected and analyzed for VOCs.

The two laboratory samples with DNAPL will be collected from the bottom 1/2–inch of soil above the boundary silt from geoprobe borings showing conclusive visual evidence of DNAPL at the base of the shallow groundwater zone. The goal of these samples is to collect as representative of a sample as possible from the soil area saturated with MCB. The samples without DNAPL will be collected from the bottom ½-inch of soil above the silt from borings in which no visual evidence of DNAPL or sheen is confirmed with a dye test.

To obtain the most representative sample of the soil conditions just above the shallow zone boundary silt, the samples will be collected from the bottom ½-inch of soil using SW-846 Method 5035A. The high concentration method for 5035A using methanol for field preservation should be used for the soil collection. The steps for performing this sampling method are as follow:

- Obtain pre-prepared soil sampling vials and jars from the laboratory. Each sample bottle set should include a 2-ounce jar for collecting a bulk sample for bulk density analysis, and two 40-milliliter (ml) vials with Teflon septa and a pre-measured and pre-weighed 10 ml of laboratory grade methanol. The methanol filled vials will be used for the VOC extraction.

- The soil sample should be collected from the soil core using a soil sampling syringe to extract a plug of soil from the zone to be sampled and extruded directly into the sample vial. Each of the two 40-ml vials with methanol should be filled with as close to 10 grams of soil as possible.

- The 2-ounce jar should be packed with soil representative of the soil matrix added to the 40-ml vials. This soil does not need to be from the highly contaminated zone as it will only be used for dry bulk density analysis so long as it is representative of the lithology.

All samples should be immediately packed with ice and prevented from freezing. Pick up of the samples by laboratory courier should be arranged for the end of each day on which samples are collected. The samples are to be analyzed by North Creek Analytical of Beaverton, Oregon, an Oregon certified laboratory. The samples are to be submitted for analysis of VOCs by SW-849 8260B on a rushed 1-week turnaround time.

Decontamination

All drilling and sampling gear must be decontaminated between each boring. The drilling rod and sampler should be rinsed with a hot water pressure washer, scrubbed with a Liquinox or Alconox solution, and then rinsed with the hot water pressure washer. Any reusable sampling tools should be scrubbed with an Alconox solution, rinsed in potable water, sprayed with isopropanol or methanol, and then rinsed again with

potable water. All decontamination water must be contained and labeled as such.

Investigation Derived Waste

All investigation derived wastes including soil cuttings and decontamination water will be contained in drums and labeled as instructed by the site manager. ERM will provide a log of the drums to the site manager at the completion of the investigation.

PROJECT SCHEDULE

ERM will begin this field work the week of December 5 and it is anticipated that the field work will require approximately 5 days. Sample results will be available 1 week following sample submittal. Data from this investigation will be used for internal review by ERM and Arkema to gauge the performance of the AS/SVE IRM and make decisions about the future operation and/or expansion of the system.

Thank you for the continued opportunity to work with Arkema. If you have questions about the attached work plan or cost estimate, or require additional information, please contact me or Dave Edwards at (425) 462-8591.

Sincerely,

Chris L. Bailey, P.E.
Project Manager

David P. Edwards, P.G.
Principal

cc: Larry Patterson/Arkema Inc.
Jason Kraus/ERM-West, Inc.
Matt McClincy / Oregon DEQ

BDM/CLB/0020155-P05-0115
Attachment

Project No. 0022725.60
Date: 11/08/05
Drawn By: Johnet Estrada
CAD File: g:\0022725\60\002272560-06.dwg

No. 2 DOCK

WAREHOUSE No. 3

LOADING DOCK

OLD CAUSTIC TANK FARM

PROCESS

FORMER ACID PLANT

FORMER CONTROL HOUSE

WAREHOUSE No. 2

CELL LIQUOR STORAGE

MWA-2, MWA-8i, MWA-3, MWA-13d, MWA-17i, MWA-9i, MWA-21b, MIP-2, MWA-4, MWA-10i, MWA-6r, MWA-16i, MWA-18, MWA-14i, MWA-5

MIP-16, MIP-14, AS-3, SVE-3, AS-4, SVE-4, NMP-5D, MIP-15, NMP-3D, NMP-2D, NMP-6D, AS-8, SVE-7, MIP/INT-11, MIP-19, SVE-6, AS-7, NMP-1D, MIP/INT-10, SVE-10, AS-5, SVE-5, AS-6, MIP/INT-12, MIP-13, AS-12, NMP-4D, MIP-8, SVE-1, SVE-9, MIP/INT-7, AS-2, AS-9, SVE-8, AS-10, AS-11, AS-1, SVE-2, MIP/INT-9, MWA-15r, MIP/INT-4, AS-17, SVE-14, SVE-11, SVE-12, MIP-6, MIP/INT-5, MIP-17, AS-14, AS-15, AS-16, AS-13, MIP-18, MIP-3, SVE-13, MWA-11i, AS-21, AS-19, AS-20, MIP-1, SVE-15, AS-18, SVE-16, SVE-17

LEGEND

- Monitoring Well, Shallow Zone
- Monitoring Well, Intermediate Zone
- Monitoring Well, Lower Portion Shallow Zone
- Monitoring Well, Deep Zone
- DNAPL Delineation Boring – Intermediate Zone
- CPT/MIP Boring
- Soil Vapor Extraction Well
- Air Sparge Well
- MPR — Manufacturing Process Residue
- Approximate Extent of Residual DNAPL in the Shallow Groundwater Zone: Dashed Where Inferred

Notes: Green symbol indicates residual DNAPL was detected in soil.

NOTE: A number of buildings and structures shown on this figure have been demolished and/or removed.

TRUE NORTH

PLANT NORTH

0 60

FEET

Figure 1

Extent of Residual DNAPL in Shallow Zone Groundwater

Arkema Inc.

Portland, Oregon

ERM 11/05

Project No. 0022725.60
Date: 11/09/05
Drawn By: Johnet Estrada
CAD File: g:\0022725\60\0022725560-07.dwg

PMP-5
AS-3
AS-4
NMP-3D
NMP-6D
AS-8
AS-7
AS-5
PMP-4
AS-6
GP-20
GP-21
GP-8
GP-7
NMP-5D
NMP-2D
NMP-4D
GP-17
NMP-1D
AS-12
GP-10
GP-9
PMP-3
AS-1
AS-2
AS-9
AS-10
AS-11
GP-14
GP-19
GP-13
MWA-15r
GP-11
AS-17
AS-15
AS-16
AS-14
AS-13
GP-15
GP-18
GP-16
GP-12
MWA-11i
AS-21
AS-20
AS-19
AS-18

WAREHOUSE No. 3
LOADING DOCK
FORMER ACID PLANT
PROCESS
FORMER CONTROL
WAREHOUSE
OLD TA

LEGEND

- Monitoring Well, Shallow Zone
- Monitoring Well, Intermediate Zone
- Monitoring Well, Lower Portion Shallow Zone
- Air Sparge Well
- GP-7 Proposed Direct-Push Sample Location
- MPR Manufacturing Process Residue

Approximate Extent of Residual DNAPL in the Shallow Groundwater Zone: Dashed Where Inferred

Notes: Green symbol indicates residual DNAPL was detected in soil.

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TRUE NORTH
PLANT NORTH
0 30
FEET

Figure 2
Proposed Direct-Push Sample Locations
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Table 1
Target Sample Intervals
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Boring	**Target Sample Interval** [a] *ft-bgs*
GP-7	31-35
GP-8	31-35
GP-9	31-35
GP-10	31-35
GP-11	26-30
GP-12	25-29
GP-13	29-33
GP-14	30-34
GP-15	25-29
GP-16	26-30
GP-17	31-35
GP-18	26-30
GP-19	28-32
GP-20	31-35
GP-21	31-35

Notes
ft-bgs = Feet below ground surface

a = Sample intervals based upon depth at which DNAPL or boundary silt were encountered in adjacent previous borings. These depths may be adjusted as field conditions require.